LINEAR TECHNOLOGY

5V Low Power RS232
5-Driver/3-Receiver Transceiver

FEATURES

- **Low Supply Current: 500µA**
- **0.2µA Supply Current in SHUTDOWN**
- 50µA Supply Current in RECEIVER ALIVE Mode
- **ESD Protection Over ±10kV**
- Operates from a Single 5V Supply
- Uses Small Capacitors: 0.1µF
- Operates to 120k Baud
- Three-State Outputs Are High Impedance When Off
- Output Overvoltage Does Not Force Current Back into Supplies
- RS232 I/O Lines Can Be Forced to ±25V Without Damage
- Flowthrough Architecture

APPLICATIONS

- Battery-Powered Modems
- Battery-Powered DCE
- Notebook Computers
- Palmtop Computers

DESCRIPTION

The LTC1338 is a 5-driver/3-receiver RS232 transceiver with very low supply current. In the no load condition, the supply current is only 500µA. The charge pump only requires four 0.1µF capacitors.

In SHUTDOWN mode, the supply current is further reduced to 0.2µA. In RECEIVER ALIVE mode, all three receivers are kept alive and the supply current is 50µA. All RS232 outputs assume a high impedance state in SHUTDOWN and with the power off.
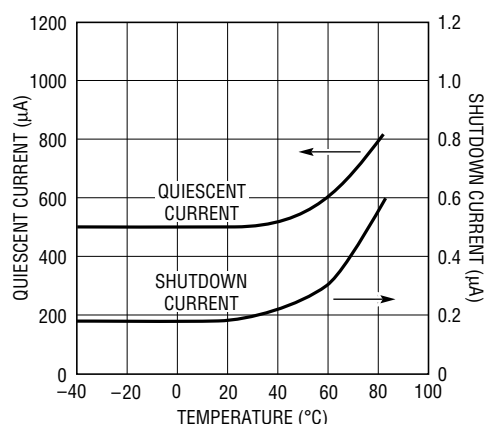
The LTC1338 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120k baud with a 2500pF, 3kΩ load. Both driver outputs and receiver inputs can be forced to ±25V without damage, and can survive multiple ±10kV ESD strikes.

TYPICAL APPLICATION

5-Drivers/3-Receivers with SHUTDOWN
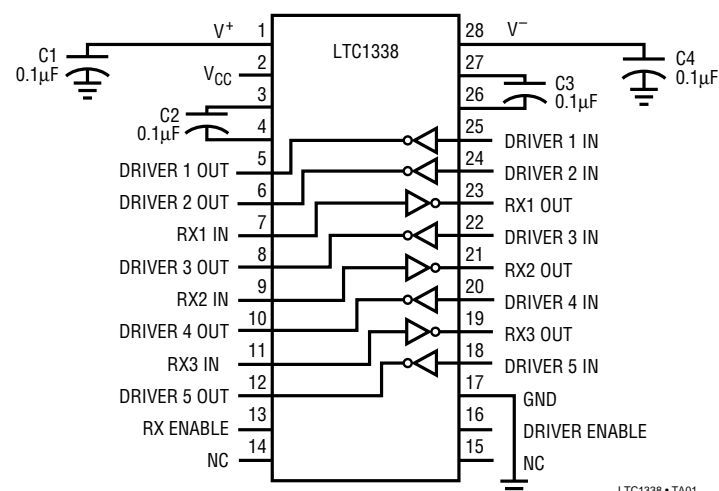
Supply Current

TEST CONDITION:
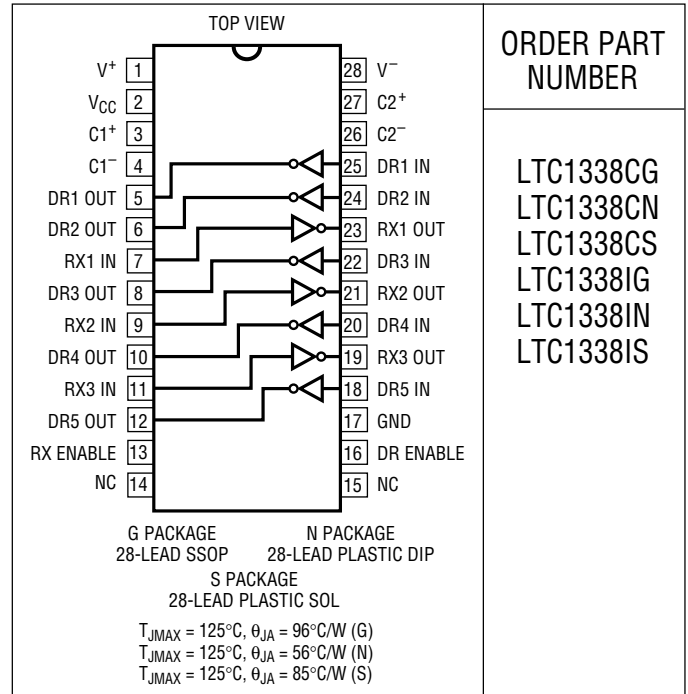V_{CC} = 5V, ALL DRIVER INPUTS TIED TO V_{CC}.

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LTC1338

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage (V_{CC}) 6V
Input Voltage
    Driver .... −0.3V to V_{CC} + 0.3V
    Receiver .... −25V to 25V
    Driver/Receiver Enable Pin .... −0.3V to V_{CC} + 0.3V
Output Voltage
    Driver .... −25V to 25V
    Receiver .... −0.3V to V_{CC} + 0.3V
Short Circuit Duration
    V^+ .... 30 sec
    V^- .... 30 sec
    Driver Output .... Indefinite
    Receiver Output .... Indefinite
Operating Temperature Range
    Commercial (LTC1338C) .... 0°C to 70°C
    Industrial (LTC1338I) .... −40°C to 85°C
Storage Temperature Range .... −65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW

V^+	1	28	V^-
V_{CC}	2	27	$C2^+$
$C1^+$	3	26	$C2^-$
$C1^-$	4	25	DR1 IN
DR1 OUT	5	24	DR2 IN
DR2 OUT	6	23	RX1 OUT
RX1 IN	7	22	DR3 IN
DR3 OUT	8	21	RX2 OUT
RX2 IN	9	20	DR4 IN
DR4 OUT	10	19	RX3 OUT
RX3 IN	11	18	DR5 IN
DR5 OUT	12	17	GND
RX ENABLE	13	16	DR ENABLE
NC	14	15	NC

G PACKAGE   N PACKAGE
28-LEAD SSOP   28-LEAD PLASTIC DIP
S PACKAGE
28-LEAD PLASTIC SOL

T_{JMAX} = 125°C, θ_{JA} = 96°C/W (G)
T_{JMAX} = 125°C, θ_{JA} = 56°C/W (N)
T_{JMAX} = 125°C, θ_{JA} = 85°C/W (S)

ORDER PART NUMBER

LTC1338CG
LTC1338CN
LTC1338CS
LTC1338IG
LTC1338IN
LTC1338IS

DC ELECTRICAL CHARACTERISTICS

V_{CC} = 5V, C1 = C2 = C3 = C4 = 0.1μF, unless otherwise noted.

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Any Driver							
Output Voltage Swing	3k to GND	Positive	●	5.0	7.0		V
		Negative	●	−5.0	−6.5		V
Logic Input Voltage Level	Input Low Level (V_{OUT} = High)		●		1.4	0.8	V
	Input High Level (V_{OUT} = Low)		●	2.0	1.4		V
Logic Input Current	$0 \leq V_{IN} \leq V_{CC}$		●			±5	μA
Output Short-Circuit Current	V_{OUT} = 0V				±12		mA
Output Leakage Current	SHUTDOWN, V_{OUT} = ±20V (Note 3)		●		±10	±500	μA
Any Receiver							
Input Voltage Thresholds	Input Low Threshold		●	0.8	1.3		V
	Input High Threshold		●		1.7	2.4	V
Hysteresis			●	0.1	0.4	1	V
Input Resistance	$-10V \leq V_{IN} \leq 10V$			3	5	7	kΩ
Output Voltage	Output Low, I_{OUT} = −1.6mA (V_{CC} = 5V)		●		0.2	0.4	V
	Output High, I_{OUT} = 160μA (V_{CC} = 5V)		●	3.5	4.8		V
Output Short-Circuit Current	Sinking Current, V_{OUT} = V_{CC}			−15	−40		mA
Output Leakage Current	SHUTDOWN, $0 \leq V_{OUT} \leq V_{CC}$ (Note 3)		●		1	10	μA
Power Supply Generator							
V^+ Output Voltage	I_{OUT} = 0mA				8.0		V
	I_{OUT} = 12mA				7.5		V
V^- Output Voltage	I_{OUT} = 0mA				−8.0		V
	I_{OUT} = −12mA				−7.0		V
Supply Rise Time	SHUTDOWN to Turn-On				0.2		ms

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DC ELECTRICAL CHARACTERISTICS V_{CC} = 5V, C1 = C2 = C3 = C4 = 0.1μF, unless otherwise noted.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Power Supply						
V_{CC} Supply Current	No Load (All Driver V_{IN} = V_{CC})(Note 2) 0°C ≤ T_A ≤ 70°C			0.5	1.0	mA
	No Load (All Driver V_{IN} = 0V)(Note 2) 0°C ≤ T_A ≤ 70°C			1.0	1.5	mA
	No Load (All Driver V_{IN} = V_{CC})(Note 2) −40°C ≤ T_A ≤ 85°C			0.5	1.5	mA
	No Load (All Driver V_{IN} = 0V)(Note 2) −40°C ≤ T_A ≤ 85°C			1.0	2.0	mA
	RECEIVER ALIVE Mode (Note 4)	●		50	80	μA
Supply Leakage Current (V_{CC})	SHUTDOWN (Note 3)	●		0.2	10	μA
Driver/Receiver Enable Threshold Low		●		1.4	0.8	V
Driver/Receiver Enable Threshold High		●	2.0	1.4		V

AC CHARACTERISTICS V_{CC} = 5V, C1 = C2 = C3 = C4 = 0.1μF, unless otherwise noted.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Slew Rate	R_L = 3k, C_L = 51pF			8	30	V/μs
	R_L = 3k, C_L = 2500pF		3	5		V/μs
Driver Propagation Delay	t_{HLD} (Figure 1)	●		2	3.5	μs
(TTL to RS232)	t_{LHD} (Figure 1)	●		2	3.5	μs
Receiver Propagation Delay	t_{HLR} (Figure 2)	●		0.3	0.8	μs
(RS232 to TTL)	t_{LHR} (Figure 2)	●		0.2	0.8	μs

The ● denotes specifications which apply over the operating temperature range of 0°C to 70°C or −40°C to 85°C.
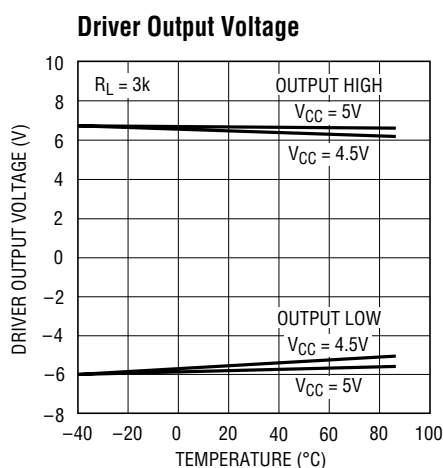
Note 1: Absolute maximum ratings are those values beyond which the life of the device may be impaired.

Note 2: Supply current is measured with driver and receiver outputs unloaded. The $V_{DRIVER\ ENABLE}$ and $V_{RECEIVER\ ENABLE}$ = V_{CC}.
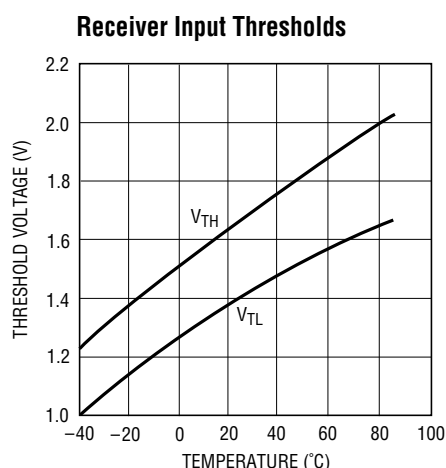
Note 3: Supply current and leakage current measurements in SHUTDOWN are performed with $V_{DRIVER\ ENABLE}$ and $V_{RECEIVER\ ENABLE}$ = 0V.

Note 4: Supply current measurement in RECEIVER ALIVE mode is performed with $V_{DRIVER\ ENABLE}$ = 0V and $V_{RECEIVER\ ENABLE}$ = V_{CC}.
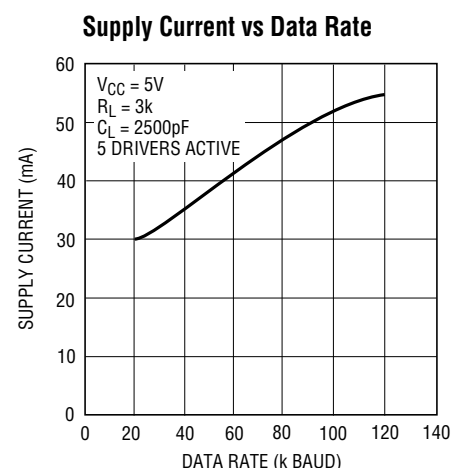
TYPICAL PERFORMANCE CHARACTERISTICS

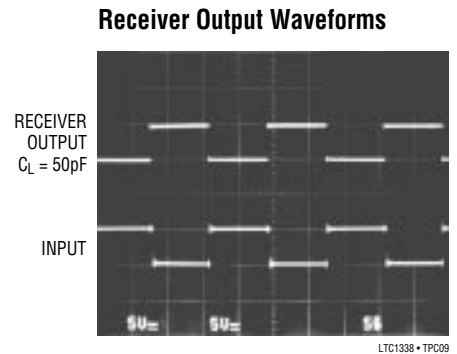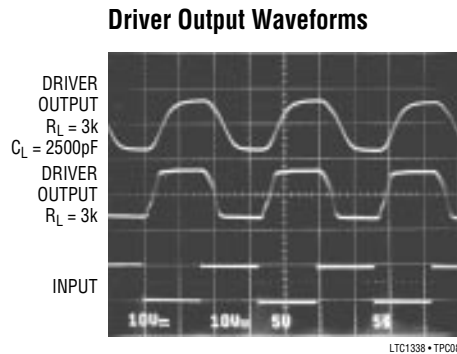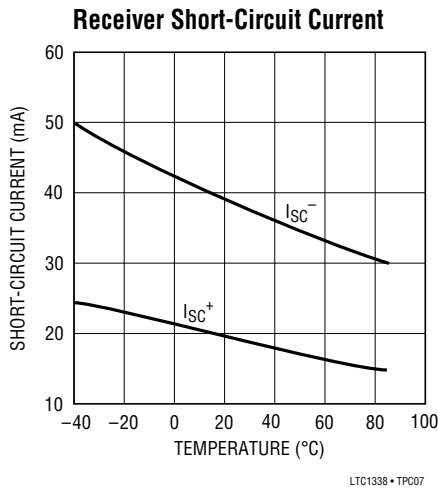**Driver Output Voltage**

LTC1338 • TPC01

Receiver Input Thresholds

LTC1338 • TPC02

Supply Current vs Data Rate

LTC1338 • TPC03

TYPICAL PERFORMANCE CHARACTERISTICS

V$_{CC}$ Supply Current

LTC1338 • TPC04

Driver Leakage in Shutdown

LTC1338 • TPC05

Driver Short-Circuit Current

LTC1338 • TPC06

Receiver Short-Circuit Current

LTC1338 • TPC07

Driver Output Waveforms

LTC1338 • TPC08

Receiver Output Waveforms

LTC1338 • TPC09
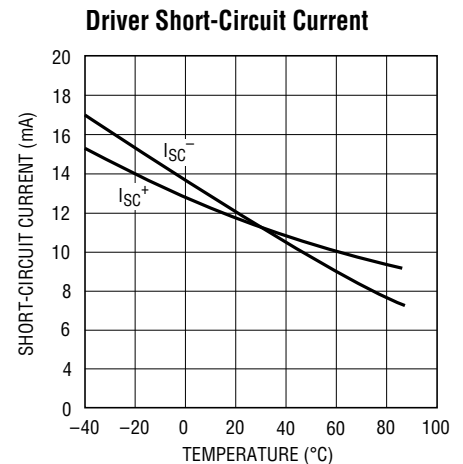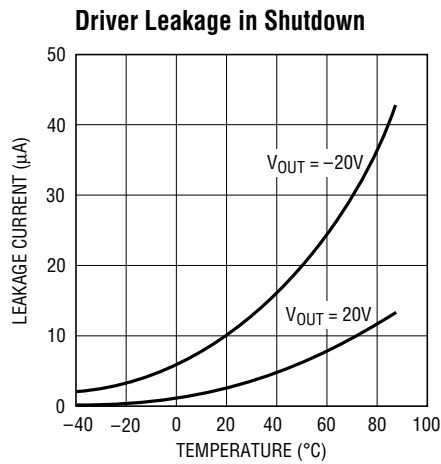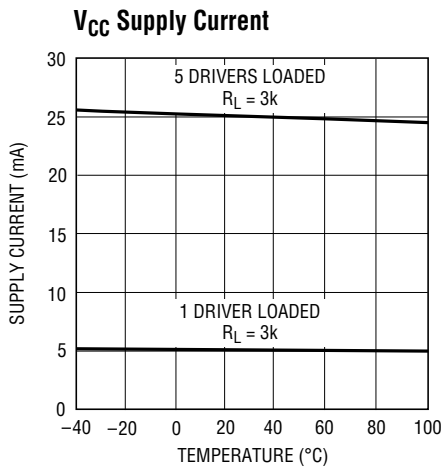
PIN FUNCTIONS

V$_{CC}$: 5V Input Supply Pin. Supply current less than 0.2µA in the SHUTDOWN mode. This pin should be decoupled with a 0.1µF ceramic capacitor.

GND: Ground Pin.

RECEIVER ENABLE: TTL/CMOS Compatible Enable Pin. Refer to Table 1 for its functional description. This pin can not float.

DRIVER ENABLE: TTL/CMOS Compatible Enable Pin. Refer to Table 1 for its functional description. This pin can not float.

V$^+$: Positive Supply Output (RS232 Drivers). V$^+ \cong$ 2V$_{CC}$ – 1V. This pin requires an external capacitor C = 0.1µF for

charge storage. The capacitor may be tied to ground or 5V. With multiple devices, the V$^+$ and V$^-$ pins may be paralleled into common capacitors. For large numbers of devices, increasing the size of the shared common storage capacitors is recommended to reduce ripple.

V$^-$: Negative Supply Output (RS232 Drivers). V$^- \cong$ 2V$_{CC}$ –1.5V. This pin requires an external capacitor C = 0.1µF for charge storage.

C1$^+$, C1$^-$, C2$^+$, C2$^-$: Commutating Capacitor Inputs. These pins require two external capacitors C = 0.1µF: one from C1$^+$ to C1$^-$, and another from C2$^+$ to C2$^-$. To maintain charge pump efficiency, the capacitor's effective series resistance should be less than 20Ω.

PIN FUNCTIONS

DRIVER IN: RS232 Driver Input Pins. Inputs are TTL/CMOS compatible. Inputs should not be allowed to float. Tie unused inputs to V_{CC}.

DRIVER OUT: Driver Outputs at RS232 Voltage Levels. Outputs are in a high impedance state when in SHUTDOWN, RECEIVER ALIVE mode or V_{CC} = 0V. The driver outputs are protected against ESD to ±10kV for human body model discharges.

RX IN: Receiver Inputs. These pins can be forced to ±25V without damage. The receiver inputs are protected against ESD to ±10kV for human body model discharges. Each receiver provides 0.4V of hysteresis for noise immunity.

RX OUT: Receiver Outputs with TTL/CMOS Voltage Levels. Outputs are in a high impedance state when in SHUTDOWN or RECEIVER DISABLE mode to allow data line sharing.

Table 1. Functional Description

| MODE	RX ENABLE	DR ENABLE	DRIVERS	RECEIVERS	I_{CC} (µA)(TYP)
SHUTDOWN	0	0	All driver outputs are high impedance.	All receiver outputs are high impedance.	0.2
Receiver Disable	0	1	All drivers alive.	All receiver outputs are high impedance.	500
RECEIVER ALIVE	1	0	All driver outputs are high impedance.	All receivers alive.	50
Normal	1	1	All drivers alive.	All receivers alive.	500

SWITCHING TIME WAVEFORMS
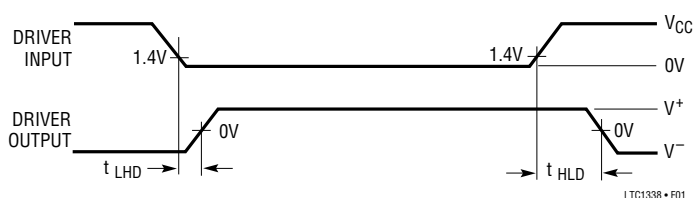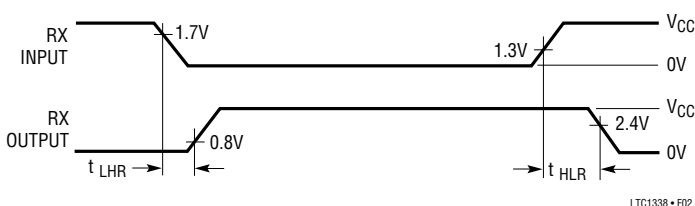

Figure 1. Driver Propagation Delay Timing

Figure 2. Receiver Propagation Delay Timing

TEST CIRCUITS

Driver Timing Test Load

DRIVER INPUT → DRIVER → DRIVER OUTPUT — 51pF, 3k

LTC1338 • F03

Receiver Timing Test Load

RX INPUT → RX → RX OUTPUT — 51pF

LTC1338 • F04

ESD Test Circuit

LTC1338

Pin	Signal		Pin	Signal
1	V⁺		28	V⁻
2	V$_{CC}$		27	
3			26	
4			25	DRIVER 1 IN
5	DRIVER 1 OUT		24	DRIVER 2 IN
6	DRIVER 2 OUT		23	RX1 OUT
7	RX1 IN		22	DRIVER 3 IN
8	DRIVER 3 OUT		21	RX2 OUT
9	RX2 IN		20	DRIVER 4 IN
10	DRIVER 4 OUT		19	RX3 OUT
11	RX3 IN		18	DRIVER 5 IN
12	DRIVER 5 OUT		17	GND
13	RX ENABLE		16	DRIVER ENABLE
14	NC		15	NC

C1 0.1µF
C2 0.1µF
C3 0.1µF
C4 0.1µF

RS232 LINE PINS PROTECTED TO ±10kV

V⁺ is pin 1; V$_{CC}$ is pin 2; V⁻ is pin 28.

LTC1338 • TC01

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PACKAGE DESCRIPTION
Dimensions in inches (millimeters) unless otherwise noted.

G Package
28-Lead SSOP
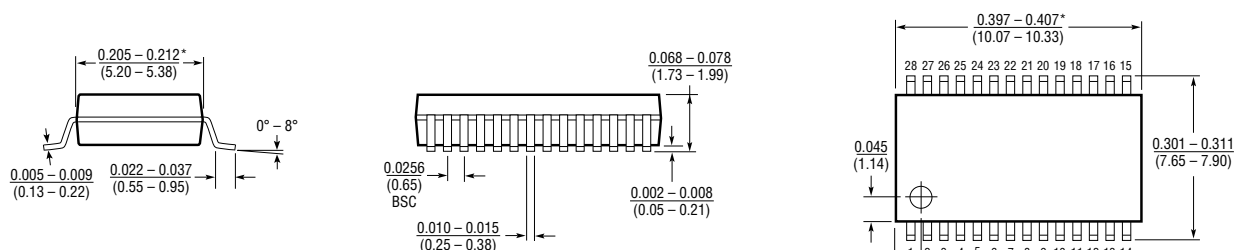
0.205 – 0.212*
(5.20 – 5.38)

0° – 8°

0.005 – 0.009
(0.13 – 0.22)

0.022 – 0.037
(0.55 – 0.95)

0.068 – 0.078
(1.73 – 1.99)

0.0256
(0.65)
BSC

0.010 – 0.015
(0.25 – 0.38)

0.002 – 0.008
(0.05 – 0.21)

0.397 – 0.407*
(10.07 – 10.33)

28 27 26 25 24 23 22 21 20 19 18 17 16 15

0.045
(1.14)

0.301 – 0.311
(7.65 – 7.90)

1 2 3 4 5 6 7 8 9 10 11 12 13 14

0.045
(1.14)

*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 INCH (0.15mm).

N Package
28-Lead Plastic DIP

0.600 – 0.625
(15.240 – 15.875)

0.009 – 0.015
(0.229 – 0.381)

0.625 $^{+0.025}_{-0.015}$
$\left(15.87 ^{+0.635}_{-0.381} \right)$

0.130 ± 0.005
(3.302 ± 0.127)

0.015
(0.381)
MIN

0.125
(3.175)
MIN

0.045 – 0.065
(1.143 – 1.651)

0.035 – 0.080
(0.889 – 2.032)

0.100 ± 0.010
(2.540 ± 0.254)

0.018 ± 0.003
(0.457 ± 0.076)

0.070
(1.778)
TYP

1.455
(36.957)
MAX

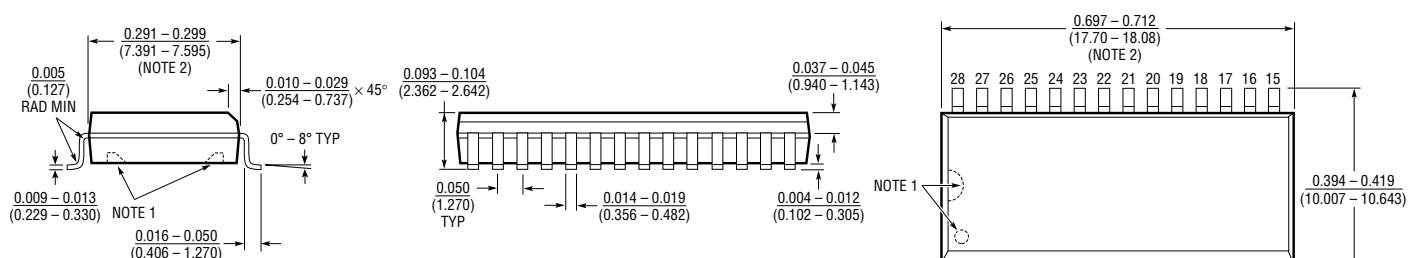28 27 26 25 24 23 22 21 20 19 18 17 16 15

0.505 – 0.560
(12.827 – 14.224)

1 2 3 4 5 6 7 8 9 10 11 12 13 14

S Package
28-Lead SOL

0.005
(0.127)
RAD MIN

0.291 – 0.299
(7.391 – 7.595)
(NOTE 2)

0.010 – 0.029
(0.254 – 0.737) × 45°

0° – 8° TYP

0.009 – 0.013
(0.229 – 0.330)

NOTE 1

0.016 – 0.050
(0.406 – 1.270)

0.093 – 0.104
(2.362 – 2.642)

0.050
(1.270)
TYP

0.014 – 0.019
(0.356 – 0.482)

0.037 – 0.045
(0.940 – 1.143)

0.004 – 0.012
(0.102 – 0.305)

0.697 – 0.712
(17.70 – 18.08)
(NOTE 2)

28 27 26 25 24 23 22 21 20 19 18 17 16 15

NOTE 1

0.394 – 0.419
(10.007 – 10.643)

1 2 3 4 5 6 7 8 9 10 11 12 13 14

NOTE:
1. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS.
   THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS.

2. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
   MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 INCH (0.15mm).

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